SMART SHOES WITH ADAPTIVE SAMPLING FOR REHABILITATION AND HEALTH MONITORING

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to, and the benefit of, U.S. Provisional Application Ser. No. 62/735,653 filed on Sep. 24, 2018, and entitled "SMART SHOES WITH ADAPTIVE SAMPLING FOR REHABILITATION AND HEALTH MONITORING." The above application is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

The present disclosure relates to healthcare, and in particular to patient health monitoring devices and approaches for use.

BACKGROUND

Prior patient monitoring systems, for example systems intended to monitor activity levels of outpatients, have suffered from various deficiencies. Accordingly, improved patient monitoring systems and improved patient monitoring methods remain desirable.

SUMMARY

An example embodiment is a smart shoe system for monitoring patient activity. The smart shoe system may include a shoe having a plurality of pneumatic pressure sensors. The pressure sensors may be configured to detect pressure at a plurality of points in the sole of the shoe. The smart shoe system may include a microprocessor coupled to the pressure sensors and a GPS integrated circuit. The GPS integrated circuit may be for correlating position of the smart shoe system to activity data generated by the plurality of pressure sensors. The smart shoe system may include a flash memory storage for storing data generated by the microprocessor and pressure sensors.

Another example embodiment is a method for monitoring an activity level of a patient. The method may include wearing, by the patient, a smart shoe system, recording, by the smart shoe system, activity information for the patient, and transmitting, to a medical provider and over an electronic network, the activity information. The smart shoe system may include a shoe having a plurality of pneumatic pressure sensors. The pressure sensors may be configured to detect pressure at a plurality of points in the sole of the shoe. The smart shoe system may include a microprocessor coupled to the pressure sensors and a GPS integrated circuit. The GPS integrated circuit may be for correlating position of the smart shoe system to activity data generated by the plurality of pressure sensors. The smart shoe system may include a flash memory storage for storing data generated by the microprocessor and pressure sensors.

Yet another example embodiment is a smart shoe. The smart shoe may include a plurality of pneumatic pressure sensors. The pressure sensors may be configured to detect pressure at a plurality of points in the sole of the shoe. The smart shoe may include a microprocessor coupled to the pressure sensors and a GPS integrated circuit. The GPS integrated circuit may be used for correlating position of the smart shoe system to activity data generated by the plurality of pressure sensors. The smart shoe may include a flash memory storage for storing data generated by the microprocessor and pressure sensors.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the following description and accompanying drawings:

FIG. **1** illustrates use of an exemplary smart shoe system in accordance with an exemplary embodiment;

FIG. **2** illustrates the bottom surface of a pair of shoe soles of a smart shoe system, with labeled sensing points at each of the silicone tube coils, in accordance with an exemplary embodiment;

FIG. **3** illustrates a flow chart of an exemplary adaptive sampling algorithm in accordance with various exemplary embodiments;

FIG. **4** illustrates exemplary algorithm results for a sitting to walking transition of a user of an exemplary smart shoe system in accordance with an exemplary embodiment;

FIG. **5** illustrates exemplary algorithm results for a walking to sitting transition of a user of an exemplary smart shoe system in accordance with an exemplary embodiment; and

FIG. **6** illustrates a flow chart of an exemplary method in accordance with various exemplary embodiments.

DETAILED DESCRIPTION

The following description is of various exemplary embodiments only, and is not intended to limit the scope, applicability or configuration of the present disclosure in any way. Rather, the following description is intended to provide a convenient illustration for implementing various embodiments including the best mode. As will become apparent, various changes may be made in the function and arrangement of the elements described in these embodiments without departing from principles of the present disclosure.

For the sake of brevity, conventional techniques for remote patient monitoring, compliance assessment, the like or some combination of these may not be described in detail herein. Furthermore, the connecting lines shown in various figures contained herein are intended to represent exemplary functional relationships, exemplary physical couplings between various elements, or both exemplary functional relationships and exemplary physical couplings between various elements. It should be noted that many alternative or additional functional relationships or physical connections may be present in a smart shoe system, components thereof, or both.

Principles of the present disclosure contemplate the use of smart shoe systems, for example for use in monitoring patient activity. In an exemplary embodiment, an adaptive sampling algorithm may be utilized in a pair of smart shoes for patients to use as a daily health monitoring device. The main hardware of each smart shoe, which may come in pairs, features four pneumatic pressure sensors that measure ground contact forces (GCFs), and may also include a global positioning system (GPS) to track the location of the user. Sampling rate of the pressure sensors and the GPS may be changed based on the activity, e.g., either walking or sitting, detected from the user's GCFs. In various operational testing, the adaptive algorithm achieved a 95% reduction in data size compared to sampling with the highest settings from all system components. Collected GPS information from a subject's activities may be utilized, displayed, or both uti-